Overview, Metadata, and Function of the Food Web Dynamics Program

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ABSTRACT

Here we provide an overview of the Northeast Fisheries Science Center's Food Web Dynamics Program (FWDP) and examine its role within the context of ecosystem-based fisheries management (EBFM). The FWDP has one of the world's largest food habits databases, encompassing the Northeast U.S. continental shelf with data from 1973 to the present. The database contains more than 500,000 stomachs from over 130 predators and has more than 1,300 different prey items. For most fish species, diet can be adequately characterized with the examination of 500-1000 stomachs. Within this fish community, most species are generalist feeders exhibiting broad diets as benthivores, planktivores, or piscivores. Given the extensive diets of most species in this ecosystem, changes in prey or predator abundance are less likely to impact populations and the community compared to ecosystems with a high number of specialists. The FWDP emphasizes recognition of patterns and processes in the fish community over large spatial and temporal scales, particularly during periods of intense fishing pressure. We continue to investigate energy budgets, fish as samplers, integrating trophic dynamics into stock assessment models, network analyses, multispecies models, aggregate biomass models, ecosystem models, ecosystem indicators, food web theory, and related applications in the broader context of EBFM.

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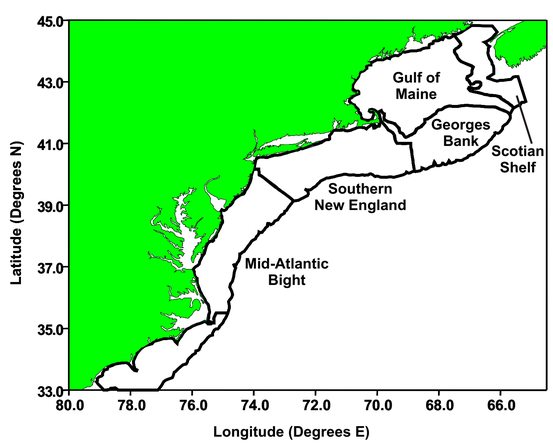
BACKGROUND

The Food Web Dynamics Program (FWDP) has four main research objectives: 1) to assess predation mortality relative to fishing mortality for commercially important fishes; 2) to mechanistically and predictively model species interactions that impact the status of these stocks, particularly critical life stages; 3) to relate changes in diet to changes in population level growth rates; and 4) to better understand the Northeast U.S. continental shelf ecosystem.

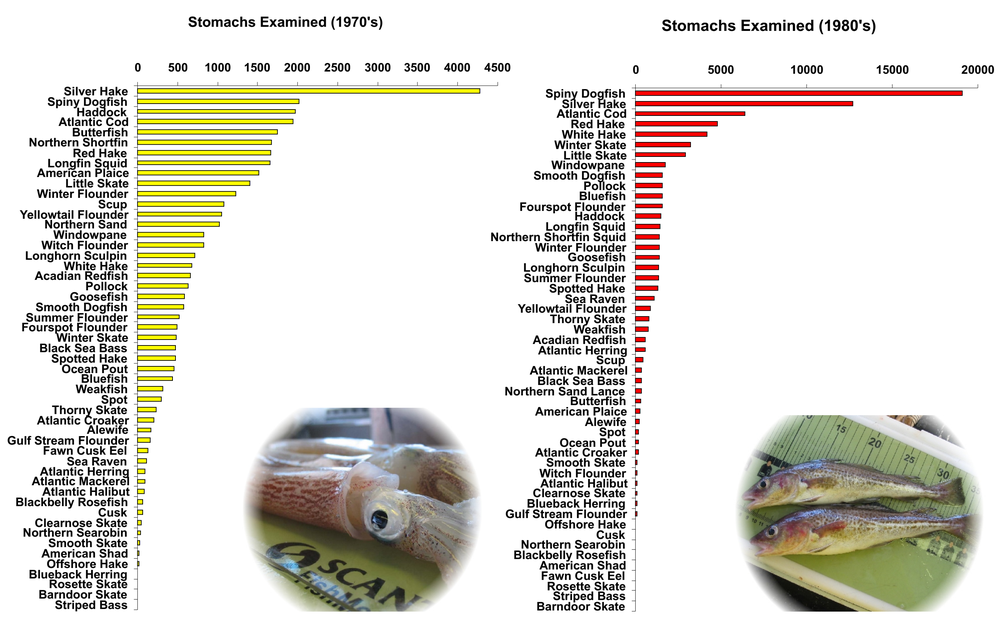
The FWDP's food habits database extends over 30 years of stomach sampling, acquiring its data from the standardized, multi-species bottom trawl surveys (BTS) conducted by the Northeast Fisheries Science Center (NEFSC) from Cape Hatteras, NC, to Nova Scotia (approximately 293,000 km^2 or 85,300 nm^2) (Grosslein 1969; Azarovitz 1981; NEFC 1988). Currently, the bulk of food habits data being examined and analyzed stems from three seasonal BTS (Winter, Spring, and Fall), sampling approximately 15,000 to 20,000 fish stomachs per year.

An important component of understanding fish community structure and function is knowledge of fish diet and prey fields. These simple observations provide necessary building blocks for the application of ecosystem-based fisheries management (EBFM).

Northeast US Continental Shelf

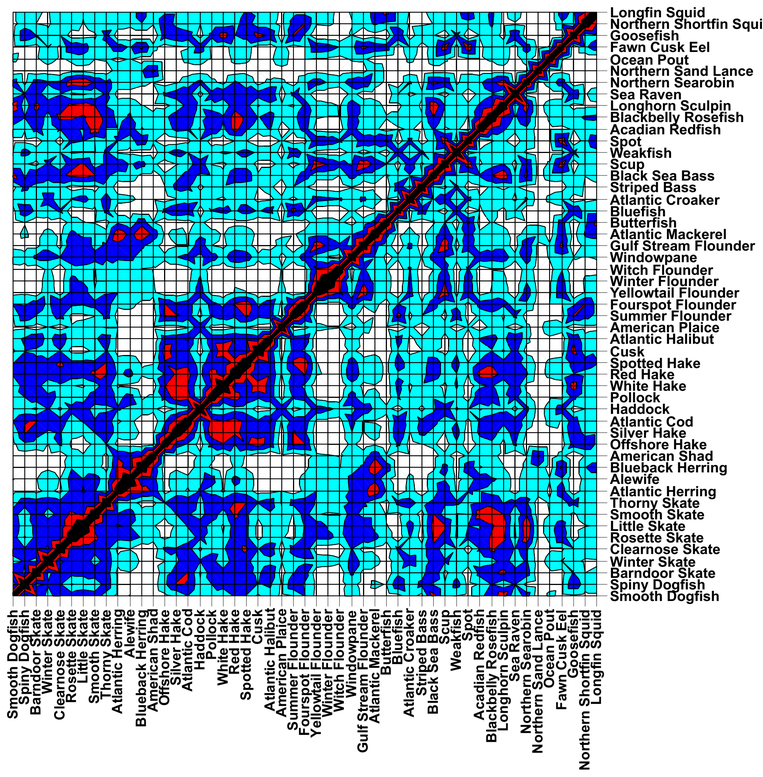


Number of Stomachs Examined by Decade



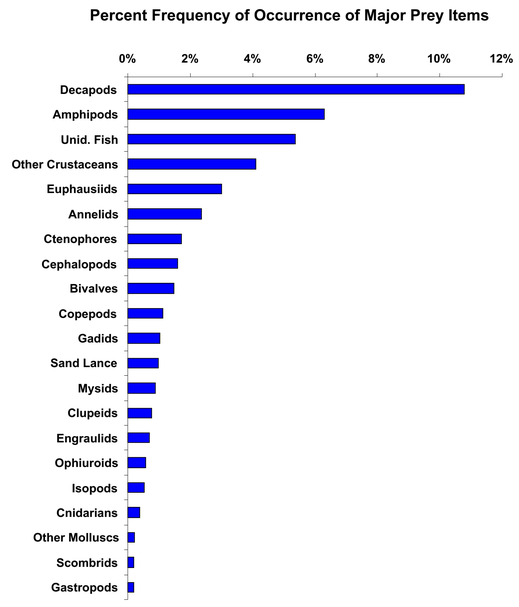
- Spiny dogfish and silver hake have been the most highly sampled fish over time.
- Stomach sampling priorities have changed over the 30+ year time series.
- In more recent years we have sampled less stomachs per species, but a higher number of species.
- We now have over 0.5 million stomachs in the database from over 130 predators.

Dietary Overlap for the NE US Continental Shelf Ecosystem

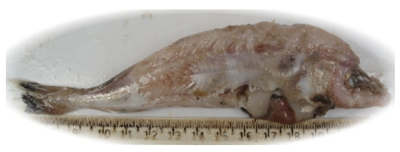


- Dietary overlap for the fish species within this ecosystem is moderate.
- There are high overlaps among the skates. Skates also have high overlaps with longhorn sculpin and sea raven.
- High overlaps exist among hakes (silver, red, and white).
- There is a high overlap among some of the benthivorous flatfish.
- Most of the diet overlaps are 0.3 or less, suggesting minimal potential for competition.

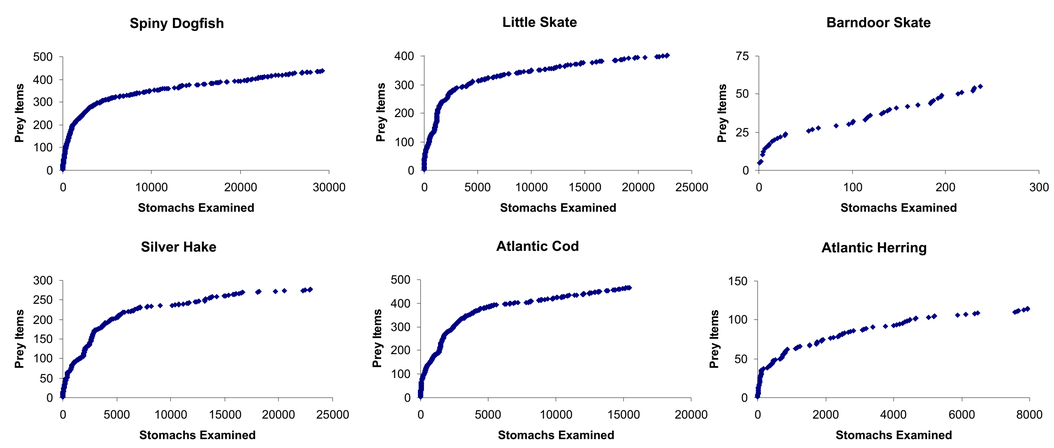
Major Prey Items from All Fish Stomachs



- Small crustaceans, particularly decapods, and amphipods, are the dominant prey of all of the fish predators in our database.
- Annelids, ctenophores, and copepods are also prominent prey.
- Unidentified fish represent another abundant item even though they are well digested.
- There were over 1,300 different prey, representing 11 different phyla.

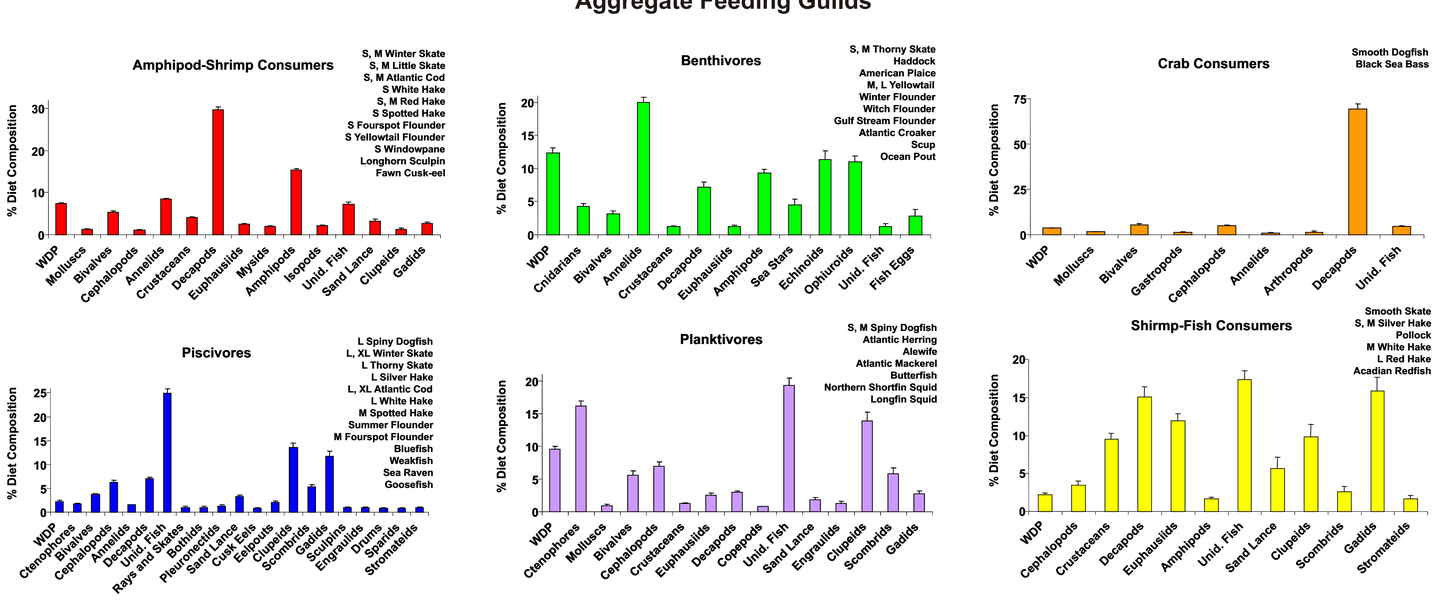


Diet Sampling Effort Coverage



- The diets for most species within this ecosystem can generally be determined by examining 500-1000 stomachs.
- For example, species such as spiny dogfish, little skate, silver hake, Atlantic cod, and Atlantic herring do not notably eat additional prey types after sampling 2000 stomachs.
- Barndoor skate and Atlantic halibut, suggest we may not have adequate sample sizes for these species.

Aggregate Feeding Guilds



S, M, L, XL = Size class (i.e. S= Small) WDP =Well Digested Prey

- The fish community for the NE US continental shelf is generally dominated by opportunistic, generalist feeders yet these species can be broken up into feeding guilds.
- Ontogenetic diet shifts play an important role in defining guild structure, especially for piscivores.
- Most guilds have one to three major defining prey taxa.
- Even so, most guilds have a broad diet. For example, even though piscivores predominantly ate fish, there was a notable amount of plankton and benthos in their diets.

CONCLUSIONS

The ongoing challenge of the FWDP is to focus on species we know little about despite their limited commercial value.

In general, changes in predator abundance and prey fields will less likely impact a fish community of generalist feeders such as the NE US continental shelf ecosystem.

Monitoring changes in fish food habits and predator abundance helps us to understand the community structure of the NE US continental shelf ecosystem. This is a core set of information for the implementation of EBFM.

If interested in collaborating, please contact either Brian Smith (Brian.Smith@noaa.gov) or Jason Link (Jason.Link@noaa.gov).

Literature Cited

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